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**NOTES ON THE ETIOLOGY AND PATHOLOGY OF "CATHETER
FEVER" WITH THE RESULTS OF AN INVESTIGATION
AS TO THE PROPHYLACTIC TREATMENT.**

BY

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THE
FEDERAL BUREAU OF INVESTIGATION
UNITED STATES DEPARTMENT OF JUSTICE
WASHINGTON, D. C.

MEMORANDUM FOR THE DIRECTOR
FROM THE CHIEF OF BUREAU
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NOTES ON THE ETIOLOGY AND PATHOLOGY OF
"CATHETER FEVER."* WITH THE RESULTS
OF AN INVESTIGATION AS TO THE
PROPHYLACTIC TREATMENT.

BY

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Not infrequently, the medical profession is startled by hearing of the sudden death of an apparently healthy individual following, merely, the passage into the bladder of a catheter or sound, but they do not hear of conditions, which, though alarming enough, are saved from publicity through their more favourable termination. I speak of what is commonly called "urethral chills," a condition far more common than would be at first supposed, but which is readily demonstrated by simply making it a routine practice to question every patient, say, forty-eight hours after passing a sound, as to their sensations since the operation. I feel sure that any person, after having made such a practice, will not feel that time is wasted in studying how to avoid producing such a chill, while for those who may not investigate the matter on their own account, it will be only necessary to quote the words of Professor Rovsing, of Copenhagen, at the British Medical Association's last meeting, to excuse bringing the subject before your notice.

His words were:—"The very greatest number of urinary infections originating from the urethra are caused by surgical interference,—examination by cystoscope, introduction of bougies, catheterization, and litholopaxy. It seems, therefore, to me to be the urgent duty of us surgeons to consider carefully by what means we can avoid the infection of our patients as the consequences of this are incalculable. At first, the general opinion was that infection was only caused by the introduction of unclean instruments, and that infection of the urinary tract might be prevented by using sterile instruments and by washing the external orifice of the urethra. The desired result was, however, not forthcoming and in the majority of hospital catheterizations, cystitis, etc., appeared and appears still with almost the same frequency as before, although instruments are disinfected most carefully."

That we may properly consider the treatment of this condition it is necessary to review the most modern views on the etiology and pathology

*Collected from the papers read at the British Medical Association Meeting in 1898.

of this disease; and these are set forth in the discussion which took place at the meeting of the British Medical Association, already referred to, on "The Origin, Effects, and Treatment of Septic Affections of the Urinary Tract."

One of the peculiarities of the human body is that certain parts or organs may be grouped together into systems, and the component parts of such systems have more or less relationship to each other, perhaps by continuity or perhaps simply by function. In these cases of relationship it is curious to notice how often the components of these systems are further related by having a similar nervous, blood, or lymphatic supply; and these relationships are also made more apparent by the liability of one member of a system to become diseased if another member is already affected, even though this disease can be proven not to have been communicated to the second organ or part by direct continuity. Let us first shortly consider the connection by continuity of the component parts of the genito-urinary system. The urethra, whose mucosa is covered with follicles, is connected with Cowper's glands, the seminal vesicles, and the prostate, and is continuous with the bladder. The bladder is connected by the ureters with the kidneys; and here it is at once apparent that if one part is infected it should be physically the easiest thing imaginable for that disease to be communicated to any other part of the genito-urinary system. This is shown by the manner in which, when the urethra is dilated and the fluid columns between the bladder and the renal pelvis are thereby rendered continuous, bacterial invasion of the kidneys takes place through these columns of urine from a septic disease of the lower urinary region. But, unfortunately, this extension by direct continuity is only one of two well-known paths. As Newman has pointed out, the course which the lymphatics pursue from the bladder is one of direct distribution along the submucous connective tissue surrounding the ureters to the capsule of the kidney. They then penetrate the renal substance, and thus, in those acute cases following urethral instrumentation in which the kidney is affected without suppuration, the virus is conveyed to the cortex of the kidney by the lymphatic channels. This connection accounts for those cases of very acute septic absorption resulting from injuries of the lower urinary tract, but especially of the upper portion of the urethra and the neck of the bladder, in which a violent septic poisoning is induced without the mucosa of the ureters or renal pelvis being affected, or, if so, only implicated in the inflammatory process to a slight degree. These cases may terminate fatally in forty-eight hours and on microscopic examination the whole of the kidney is found to be completely permeated, and the walls of the bladder and the ureters are likewise infiltrated with septic micro-organisms.

In the foregoing remarks on infection we have implicated ourselves in the etiology and pathology of the disease under discussion. These two elements of this disease have in the past been much disputed, but roughly we may state that the two great theories of the disease were:—

(1) The septic theory: (2) the nervous theory.

Recently it has been clearly demonstrated, I think, that neither sepsis alone nor the nervous system alone is responsible in any given case, but, in all probability, the two factors acting together have produced the disease,—sometimes the septic symptoms predominating and at other times the nervous.

Guyon showed that microbes may even enter the bladder without bad effect, if the bladder resistance is normal. If, however, it be diminished as, for instance, by a foreign body, injury, or residual urine, trouble may be anticipated. When we remember how each instrumentation is known to cause a modification of the urethral circulation,—any instrument introduced really being a foreign body,—and when we consider the influence of the nervous system upon inflammatory processes as well as upon resistance (either by impairing the nutritive activity of the part or by diminishing phagocytosis), it is difficult to say to what extent instrumentation of the urethra or bladder acts by reflex irritation through the nervous system, and to what extent by the introduction of sepsis. The influence of the nervous system is demonstrated in those cases where the passage of a sterilized bougie may be followed by the complete suppression of urine, which suppression is probably due to a reflex spasm of the renal arterioles. In such cases the circulation in the bladder is also interfered with and, should any contamination have been introduced, the danger of acute sepsis of the whole tract is very great. It seems very doubtful, however, whether the nervous system alone can be at fault in any case of urethral chill. But, as Newman pointed out, in any case, if the bladder fails to empty itself completely, as from urethral stricture, local or general paralysis, enlargement of the prostate or other cause, the danger of sepsis by the most minute particles of infection cannot be exaggerated. In such cases the mucous membrane loses its resisting power and the retained contents of the bladder become contaminated by even the smallest inoculation of infective material introduced from without. The discovery that the normal urethra swarms with microbes, often pathogenic, explains the cause of the disappointment of those who, when antiseptic treatment was first introduced, supposed that infection was due to the non-disinfected instrument; and great was their surprise on finding that the number of cases of catheterization infection was but slightly reduced in spite of the most careful sterilization of instruments. The number of microbes is greatly increased in those cases in which instrumentation is called for, e. g., examination

by cystoscope, introduction of bougies, catheterization, and litholopaxy; and coincidently with such increase in the bacterial habitant of the urethra is the danger of infection increased.

Now that we have seen that not only is sepsis a most important factor in the origin of urinary fever, but that disturbance of the nervous system will facilitate absorption, that although the instruments may be perfectly sterile, chill may be caused by displacing pathogenic bacteria and especially if this displacement be combined with injury by careless instrumentation, or with an already existing lesion, we must consider what can be done in the way of prophylaxis against this disease.

Two measures may be discussed; first, that which will lessen deleterious nervous influence, and secondly, that which will prevent sepsis. To combat the first, our only resource is to perform the operation with the utmost gentleness, and to carry this out we should never use more than one instrument at the first *séance*. A steel sound of smaller calibre than 20 French, should never be used. In the case of extremely nervous patients, it is better to use only soft bougies until they are accustomed to instrumentation. Sounds should never be passed more than twice or at most, three times a week, and it is found safer not to increase the calibre of the sounds by more than one or two sizes at a *séance*, the surgeon taking great care not to hurt his patient by the introduction of the instrument. If one cannot be passed through a stricture without hurting the patient it is best to employ a smaller sound, or even a bougie for a time, and only return to the large one when it is felt that it can be used without giving pain to the patient. In introducing a sound, when its progress is obstructed by the triangular ligament, it is preferable not to lift the sound's point to get it through, but to relax the subpubic ligament by pressure from above.

We must now consider how it is possible to guard against septic absorption, when it is known that the urethra is generally considered to be irretrievably septic, and thus we come face to face with certain dictums almost as unchangeable as the laws of the Medes and Persians. (1) Never use an instrument until the urine has been rendered apparently sterile by the use of such agents as salol, boracic acid, or, perhaps best, urotropine. (2) Always be sure that instruments are absolutely sterile for, although we know of many instrumentations with sounds simply washed in hot water and perhaps rubbed down with a sterile cloth, often without the slightest ill effects, we must confess that it is preferable to use none but boiled instruments. (3) Never pass a sound into the bladder if the stricture is in the anterior urethra alone; as the passage into the bladder certainly increases the danger of septic absorption.

In some hospitals another prophylactic measure is used. The bladder is injected through a catheter with Tiersch's solution which is thus

passed out by the patient. This has proven to be a most valuable addition to former treatments, but the objections to this scheme of treatment are that even a soft catheter is more or less an irritant to the mucosa, already disturbed by the passage of a sound; and again the soft catheter may force into the bladder some of the lubricant used on the instrument and which has adhered to the urethral mucosa. The disadvantage of this consists, not only in the possibility of introducing micro-organisms from the urethra in the lubricant, but also, in the case of an insoluble lubricant, by the theoretical possibility of the matter introduced forming a nucleus for stone. It may here be interesting to note that Rovsing found in a post-mortem examination of a patient dead from typhoid fever, the urinary bladder half-filled with vaseline collected there by daily catheterization for two months. Another objection is that the urethra is but imperfectly and perhaps superficially washed out by the extrusion of the injection from the bladder.

We have now stated the prophylactic measures most usually employed and have seen that, although the injection of an antiseptic solution through a soft catheter into the bladder is far better than doing nothing in the way of washing out the bladder, still this method has certain objections. And here, perhaps, it will be well to consider other matters which may be of the utmost importance.

Swinburne has demonstrated that an instrument should never be passed into the bladder while a discharge containing micro-organisms is present, thus showing the necessity of the constant use of the microscope by all genito-urinary surgeons. This rule is made practical through the knowledge that with irrigations by the method about to be explained, all micro-organisms seen in a discharge can be removed for a period long enough to permit the safe use of the sound, and which, if used properly, will have the mucosa in a normal condition before their return.

Another important point is that a sound or other instrument should not be used without first thoroughly irrigating the urethra, and if possible the bladder also, with a hot antiseptic solution, and repeating this immediately after instrumentation. This second irrigation, however, may be supplemented or its place taken by an instillation of 2 per cent., protargol into the bladder. Here I may mention an improvement suggested and adopted by Swinburne. A set of sounds which resemble an Ultzmann's syringe are used by him. The sound is tunnelled, and so made that it may be screwed to a syringe barrel. Thus, before withdrawing the sound, the surgeon may instill into the bladder about an ounce of a 2 per cent. solution of protargol. Rovsing, also, is a firm believer in the instillation of a germicide into the bladder after instrumentation, he having used for nearly ten years past a 2 per cent. solution

of silver nitrate, which he leaves in the bladder for three to four minutes and then has evacuated *per vias naturales*, following such evacuation by lavage with sterilised water. He claims that in the hundreds of cases in which he has used this method he has had no failures. But, according to some observers on this continent, he hardly goes far enough, for, to use his own words, he only employs it "in all cases of single introduction of an instrument under circumstances where infection is to be feared." The only other objection to the method is that it consumes more time than irrigation from the meatus and does not go so far as irrigation or instillation with protargol. It has the additional danger of causing some pain to the patient.

The irrigation of the urethra and bladder with hot permanganate solution from the meatus which has been referred to is done in the following way :—

The irrigator is slung five feet above the patient's penis. The patient sits or stands holding a pus basin under his penis with his left hand. The surgeon places himself on the right side of the patient and, grasping the penis with his left hand, irrigates with his right, alternately ballooning the urethra with the fluid and allowing it to escape. The urethra must be washed in this way inch by inch, first washing the meatus and guarding against the driving back of septic material from the first inch into the parts behind by tightly compressing the urethra at intervals of one to two inches until the pubic bone is reached. When the urethra has thus been carefully washed the bladder must next be washed out. This is done by gently filling the urethra and asking the patient to urinate, and in all probability his efforts will be rewarded and the surgeon will feel the purring sensation characteristic of the unobstructed flow of the solution into the bladder. Here it is necessary to be extremely careful not to hurt the patient. If he cannot voluntarily take it into his bladder by trying to urinate, not to let him persist, as the risk is run of causing an epididymitis, which will certainly not be appreciated by the patient. In the event of being unsuccessful with this it is better to risk the irritation caused by a soft catheter (after the danger of introducing septic material has been abolished by the previous copious irrigation of the urethra), and instill into the bladder one ounce of a 2 per cent. solution of protargol. The only objection that can be raised to this method is the time consumed; but results will repay this. I have passed several hundred sounds after using this method without producing a chill, and Valentine claims that he has passed thousands without a chill; even going further and stating that a chill does not follow instrumentation and copious irrigation with potassium permanganate. Not only is Swinburne, who perhaps of all men has had the greatest experience in the use of irrigation in urethral disease, strongly in favour of this method, but I understand that MacEuan of Dundee also approves of it.

